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Political Economy Of Space Exploration In Nigeria

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ABSTRACT
The broad objective of this study is to examine whether space exploration can lead to the attainment of national development. This is because despite the fact that Nigeria has launched several satellites in the orbit, she is still a technologically colonialized and weak country as all her satellites were contracted to foreign established companies and launched outside her territory. The Marxist political economy approach through Marxist production analysis was deemed suitable for the study. The central premise of this approach was that the mode of production in material life determines the general character of both the social, political, economic and spiritual process of life. The finding revealed that Nigeria space activities is not domesticated. This is because space issues are left in the hands of political laymen and not with trained scientists and technicians. Due to the nature of this study, descriptive research method was used in order to address the study. Sources of data were mainly from secondary sources gathered from published books related to the field of study, journals and internet. The study therefore recommends that for the attainment of national space development, Nigeria must focus on adequate funding in areas of research and science Education, Engineering Development, Design and Manufacturing particularly in the areas of instrumentation, Rocketry and small satellites as well as in satellite data acquisition, processing, analysis and management of related software.
Keywords: Space, satellite, launch, technology, sustainable, NigeriaSat, production.

INTRODUCTION

Humans have always been explorers. When ancient peoples stumbled upon unknown lands or seas, they were compelled to explore them. They were driven by a desire to dare and conquer new frontiers and a thirst for knowledge, wealth, and prestige. At that time, and indeed continuing to this day, the appropriate government policy to spur economic activity to national advantage has remained of paramount importance to nations (King and Kutta, 1995).

In 1957 the first object to be put into space was launched. This was sputnik, a small satellite that orbited earth. Since then, more and more objects have been put into space to provide us with information about the planets, the stars and the universe (Biswas, 2006). Before hand, the only way to learn about space was to look at the sky from Earth.

The advancement in science and technology have or enhanced a direct result of space exploration. Space exploration have made our world smaller, and the universe much larger. Today, a multitude of satellite orbits the Earth, monitoring our weather and environment, as well as provide global communications (Logsdon, 2017). The number of everyday objects and technologies that have been developed as a direct result of space exploration is astonishing. Space derived innovations are used in our daily life. The techniques such as laser surgery and brain scans are the results of space research.

Achieving space flight enabled humans to begin to explore the solar system and the rest of the universe, to understand the many objects and phenomena that are better observed from a space perspective, and to use for human benefit the resources and attributes of the space environment. All these activities –

discovery, scientific understanding and the application of that understanding to serve human purpose are elements of space exploration.

Although the possibility of exploring space has long excited people, only national governments could afford the very high costs of launching people and machines into space. Space programs have increased knowledge, served as indicators of national prestige and power, enhanced national security and military strength, and provided significant benefits to the general public (ISECG, 2013: Pp. 4-5). Most space activities have been pursed because they serve some utilitarian purpose, whether necessary knowledge, adding to national power, or making a profit.

Recognizing the significant role of space exploration in the attainment of rapid sustainable and socio-economic development, Nigeria took a bold step by putting in place a space agency National space Research and Development Agency (NASRDA) to stimulate the generation of both tangible and intangible benefits of space exploration. To a great extent, the human space exploration is very useful to think about and work with by which the protection of future society is ensured.

In this time of changing world order, with prosperity on one hand and economic turmoil on another, space exploration offers the potential of the resources of the universe, which will likely become increasingly important as Earth's resource dwindle through exploitation and use. Spin-offs according to (Baker, 2000) have thus become one classical argument for government funding of space activities.

A society that fails to invest in the future may have no future at all. If we are looking at space benefits and spin-offs, we find the common denominator in dedication to the understanding of the universe through systematic investigation and measurement, through the harnessing of curiosity, training in science and technology, discipline and instrument (Greenberg, 1971). For the substance of space exploration is in the procedures and results of research experimentation. The substance is centred in the laboratory, to trained personnel and not politicians. In the words of Goudsmith (1947:191), "the failure of German nuclear physics during world war II, can in large measure be attributed to the totalitarian climate in which it lived…. By putting politics first and science second". Nigeria should learn from this mistake to make space research a highly specialized activity separated from laymen politics and invest heavily on domesticated satellite technologies.

THEORETICAL PERSPECTIVE

The theoretical framework of analysis adopted in this study is the Marxist political economy through Marxist production analysis. That was done for the first time by (Marx, 1969) and other proponents includes (Ake, 1981, Offiong, 1980, Nnoli, 1981, Althusser, 1969, Poulantza, 1973, Gramsci, 1971, Thorndike, 1978, Momoh and Hundeyin, 2005).

This framework is applied in the understanding and explanation of space exploration in Nigeria as it adequately locates science and technology as part and parcel of the production process. It is only under this framework that the dynamics of space production process and its control system in given adequate attention and explanation. Space exploration outside a specific mode of production though obvious, cannot be easily understood until located within the dominant production process.

This framework recognized production as the basis of human existence, the pivot around which other human activities revolve (Agbu, 1992). Human society advances with the progress of the production process. Since the end of primitive communalism, the development of production has been tied to class struggle. In disproving Hegel's idealist philosophy which stressed the motivate force of ideas in society, Marx quoted thus:

> "The mode of production of material life conditions the general character of the social, political and spiritual processes. It is not the consciousness of men that determine their existence but, on the contrary, their social existence determines their consciousness" (Marx, 1977).

Basically, Marxism is a framework of political economy based on the methodology of historical and dialectical materialism (Althusser, 1969). By the use of dialectics, Marx is able to present a scenario of

continuing contradiction in society. This contradiction is seen to exist both within and between classes at different stages of their development, and also between the constantly developing forces of production and existing social relations of production (Thoradike, 1978: 62).

According to the Marxist methodology, the casual factor for contradiction in society is the requirements of production. Accordingly, production is seen as process in which three elements interact with each other. The first of these is the object of labour, that is, that which is the objectives of human activity. The second element is the instrument of labour, that is, that by means of which men exert influence, whether directly or indirectly on the diverse objects of labour. The objects of labour and the instruments of labour make up the means of production. These constitutes the material basis, or foundation of production. The third element is labour itself, that is man's purposeful activity by means he exerts an influence on nature, and adopts its force and substances to the satisfaction of his requirements. The more developed all these elements, the mightier is man's power over nature, and the more abundant the fruits of his labour (Abalkin, 1983: 16). These elements taken together characterize the productive power of labour, the productive forces of the society.

However, production is always a social process and is characterized not only by man's relations with nature but also by the relations which take shape between the people themselves in the process of production, namely, the relations of production. The key analysis in this approach is class, and the world society characterized by a global economy becomes the level of analysis. Classes are the basic units in history, and the struggle between classes occupies the centre stage. The motive force, the internal contradiction within society where the state as observed is merely contiguous to the development of owners and controllers of the means of production. The transnational characteristic of class is a dominant factor on itself, with the state as a derivative. State control of launchers technologies is the only way to guarantee national access to space dominance.

The significance of political economy framework is that its utilization makes for a deeper degree of scrutiny. It is the only framework which adequately pinpoints the locus of production and explains this process in terms of control of the process. It is holistic in view and exhibits more interdisciplinary tolerance by utilizing its own mode of analysis of man in society. It basically recognized the world as being dominated by an international political economy, characterized by a vista of international powerful state machines of ruling class interests concretely based on, and reacting to the basic imperatives of production. Using the framework, space exploration becomes parts of the international production system. As stated earlier, every system of production consists of labour power, tools of production, objects of labour and the social relations of production (who determines what, when and how). This is the relationship involving the controllers/owners of the means of production and non-owners/consumers. Those who control the production system set the goals and greatly determine the direction of development.

Indeed, space exploration is characterized by cooperation, negligible to acute disparity in the control of the process by actors. A production process characterized by dominant/underclass relations. The age of space exploration has evolved during the period in which capitalism and the neoliberal framework have achieved dominance. Since capitalist do not easily give up their monopoly they would rather withhold or hoard scientific knowledge which give them advantage over theirs. (Class struggle invariably informs the operation of space exploration. Hence, in understanding the political economy of space exploration in Nigeria, the emphasis should be on the dynamics of control over the instrument of production i.e. satellite technologies.

HISTORY OF SPACE ACTIVITIES IN NIGERIA

Nigeria, a large country located in western Africa with an area of over 900,000 square kilometers and over 155 million people (Eze, 2012) is the world's eighth most populous country. Nigeria's significance goes beyond the limits of demography and extends to an enormous economic potential.

Nigeria, emerging space-faring country have already established space agency whose activities are guided by approved space policy and possess significant level of expertise in satellite technology mission and space science and astronomy. The National Space Research and Development Agency (NASRDA)

was established in 1999 and administered by the National council on space and technology. It seeks to "build indigenous competence in developing, designing and building appropriate hardware and software in space technology as an essential tool for the socio-economic development and enhancement of the quality of life of its people (NSP, 2000). Rather than using one central agency and location, NASRDA is made up of six geographically distributed development centres (Boroffice, 2008) as follows:

Centre for Basic Space Science. This centre located at the University of Nigeria, Nsukka and Maiduguri is focused on developing an educational and research base in space science. Without a sound educational and research base in the field of basic space science, there cannot be any expectation of practical benefits for the country's citizens.

The National Centre for Remote Sensing. This centre situated in Jos, is the technology developed to obtain primary data about objects on the surface of the earth from space altitude. This is accomplished by making use of the energy emitted, reflected, or retracted by the sensed objects. The information obtained through this process is used for the assessment and management of natural resource as well as the environment.

Satellite Technology Development Centre. The satellite technology development centre in Abuja, has its primary focus on the development of satellite payloads for both geostationary and non-geostationary satellites. The centre collaborates with Surrey Satellite Technology limited of the United Kingdom for the development and launching of Nigeria's first orbital satellite, NIGERIASAT-I.

The Centre for Geodesy and Geodynamics. The centre located at Toro/Bori, (Bauchi State) form an integral part of the National participation in all international co-operative programs and projects for applied space Geodesy consistent with the goals for national-security, economic development and environmental hazard monitoring and management. It addresses national issues like: (a) surveying and mapping, (b) Remote sensing for mineral exploration, (c) coastal deformation and subsidence, (d) floods and global mean sea level monitoring.

Centre for Space Transport and Propulsion. The centre in Lagos, works on the development of locally built rocketry. It is noticed that the high level advancement and development record in telecommunication, meteorology, space exploration and military technology in America, Europe and Asia have been possible through the spirited efforts of their engineers and scientists and genuine national policy focused on rapid advances in the sciences and technology of Rocketry. In view of the above, it became imperative and expedient for Nigeria to develop and acquire Rocket technology capability.

Centre for Space Science and Technology Education. The centre situated at Obafemi Awolowo University, Ile-Ife, is focused on enhancing the skills of those who are already knowledgeable in space science, including university educators, research scientist and other personnel. In other words, it is an institution for those who already have one form of knowledge or the other on space science and technology.

In recent years, Nigeria has developed a series of satellites. Because, she did not have the capacity to design, develop and launch satellites on her own, Nigeria have worked with international partners to develop these capabilities. According to Nigeria Space Research and Development Agency (2009), the first Nigerian earth observation satellite, NigeriaSat-1, built by Surrey Satellite Limited (SSTL) of the United Kingdom was successfully launched into low Earth Orbit (LEO) from plesetsx, Moscow, on 27 September, 2003, on a Kosmos Rocket along with two other Disaster monitoring constellation (DMC), micro-satellites-UK DMC and BiLsat (Turkey satellite).

The choice of a micro-satellite using current technology was influenced by its low cost, affordability and the advantage of performance comparable with the expensive large satellites and then possibility of supporting capacity building. NigeriaSat-1, a micro-satellite deployed in a polar sun-synchronous orbit at an attitude of 680km is a 100kg spacecraft with push-broom scanning technology, and designed for a 5-year minimum lifespan. It has a swath width of 600km and imaging payload, is 3-band multi-spectral imager in the green, red and near-infrared bands 0.52-0.02 (green), 0.63-0.69 (Red), 0.273-0.9 (NIR), and has a ground sampling Distance (GSD) spatial resolution of 32m. The spacecraft has on board data storage capacity of 2 x 0.5 abyte SSDR to support imaging activities, with a store and forward communications system (Boroffice, 2008).

Meanwhile, on August 17, 2011, on a Dnepr-I launch vehicle using the SHM (Space Head module) configuration from the Yasny/Dombarovsky, launch site located in the Orenburg Regin, Russia, NigeriaSat-2 was launched (Agboola, 2011). National space Research and Development Agency (NASRDA) awarded a contract to SSTL (surrey satellite technology Ltd of Guildford, UK, to develop and build NigeriaSat-2, including the related ground infrastructure and image processing facilities. The NigeriaSat-2 satellite is designed with some key Nigerian objectives in mind:

- To support mapping and security applications
- To support food supply security, agricultural and geology application.
- To provide continuity and compatibility with the existing NigeriaSat-1system.

In addition to requiring both medium and high resolution imaging capability, the satellite must also:
(a) provide timely global imaging access (b) deliver a high data throughput, (c) support a number of special imaging modes (d) provide high accuracy geolocation knowledge of the imagery acquired, and (e) be capable of fast slew maneuvers (space daily, 2012). The satellite can be operated as a stand-alone system but it has also the capability to interface with existing NASRDA Systems (NigeriaSat-1) and to provide its services within the DMC (Disaster Monitoring Constellation) Consortium. Using the very high resolution imager on NigeriaSat-2 will be possible to see individual roads and dwellings, to understand the population density in an area and use the information to plan improvements to national infrastructure, e.g roads, water, and electricity. The imagery of both NigeriaSat-1 and NigeriaSat-2 space craft will serve as a catalyst to the development of Nigeria's NGDI (National Geospatial Data Infrastructure) program (Agbaje, 2010). NASRDA will also facilitate efficient production, management, dissemination and use of geospatial information for the attainment of the SDGs (Sustainable Development Goals). The development of NigeriaSat-2 involves also on the job training of NASRDA engineers at SSTL. The training is considered a major benefit in capacity building for Nigeria's strive to a modern and industrialized economy.

Furthermore, Nigeria in pursuance of the national policy on ICT (Information communication Technology), launched a communication satellite to provide a backbone for the ICT services particularly in the areas of e-learning, e-commerce, e-government, tele-medicine, tele-education, rural telephone etc. The super hybrid communication satellite, NIGCOMSAT-1, based on the Chinese DFH-4 Bus and featured 4C-band, 14 Ku-band, 8 ka=band and 2 L-band transponders was successfully launched on 13.05.2007 on a CZ-3B/G2 booster (Agboola, 2011). In 2008, Nigcomsat-1, lost power from the southern solar array due to a technical error of the satellite's northern solar array and was sent to a graveyard orbit as it became apparent that the satellite could not be recovered.

NIGCOMSAT-IR was launched in 2011 to replace the de-orbited Nigcomsat-1. The satellite was built and hosted by China Great walls industry cooperation. The spacecraft is built on Dong Fang Hong 4, DFH-4, Satellite bus developed by China Academy of Space Technology (CAST), and launched by LM-3B launch vehicle developed by China Academy launch vehicle CALT. NigComSat-IR is the 8^{th} satellite built on the DFH-4 but for in-orbit delivery and is the 18^{th} flight of LM-3B launch-vehicle and the 154^{th} flight in the series of the long March launchers (Agu, 2011).

Based on its growing sophistication, coordination, in understanding the place of space exploration in Nigeria, the emphasis should be on the dynamics of control over the instruments of production. Nigeria is just a consumer of satellite technologies as both satellites, NigeriaSat-1 and NigeriaSat-2, were built at Survey Satellite Technology Limited (SSTL) in Guildford, under contract with the Nigerian National Space Research and Development Agency (NASRDA).

BENEFITS STEMMING FROM SPACE EXPLORATION

Recognizing the significant benefit of space exploration for the attainment of rapid sustainable socio-economic development, the federal government of Nigeria embarked on satellite system development which resulted in the launch of the NigeriaSat-1, NigeriaSat-2 and NigComSat-IR. Nigeria is also committed to the building of the Africa Resources and environmental management satellite constellation (ARMS). All these activities will serve as catalyst to the development of the country's national geospatial data infrastructure (Agbaje, 2010).

The term "sustainable development" has been popularized by the world commission on Environment and Development (WCED). In its 1987 report entitled, "our common future" (WCED, 1987). The commission defined sustainable development as "the development that meets the needs of the present without compromising the ability of future generation to meet their own needs". The world summit on sustainable development (WSSD) in Johannesburg, South Africa (WSSD, 2002) identified top ten strategies for the successful achievements of sustainable development some of which are: poverty eradication and sustainable livelihoods, changing unsustainable patterns of consumption and production, access to energy and energy efficiency, finance and technology transfer, etc.

The Johannesburg WSSD came at the heels of the adoption of the eight (8) Millennium Development Goals (MDGs) in 2000, when all member states of the United Nations agreed to articulate policies, strategies and plans which will facilitate the achievement of the goals in order to address the problem of poverty and promote sustainable development (MDGs, 2000). This agreement could be seen as a defining moment for global cooperation in the 21st century especially in the science and technological skills required to achieved these laudable goals.

The main strategies for achieving sustainable development initiatives include technology and skill acquisition, natural resource management, infrastructure development. Accordingly, many societies around the globe are embarking on initiatives and developing agenda towards achieving these goals. However, in Nigeria, poor quality data collection, organization and management practices including lack of adequate infrastructure and skilled human capacity to develop the natural resources and manage the environment in a sustainable manner are identified factors that hindered the realization of the goals.

From the early days of space flight, it became apparent that space exploration was an efficient driver for basic science and technology. Nigeria is one of the countries in Africa that have taken steps towards establishing National Geospatial Data Infrastructure (NGDI). The NGDI system and data will effectively address Nigeria's geospatial data needs which is germane to her socio-economic development. Accurate geospatial products and NGDI capabilities and benefits provided by a common standardized geospatial clearing house accessible by key government agencies will be used for infrastructure contingency, and security planning, environmental monitoring especially in the Niger Delta etc (Agboola, 2011).

The National space Research and Development Agency (NASRDA) established with a mission to pursue the development and application of space science programme constitutes an important component of national strategy for socio-economic development through space application and participation in the global industry. The overall agenda of the Nigeria's space agenda is geared towards sustainable national development and security including the development of new resources, understanding of our Environment and Maintenance of National Security (NASRDA, 2004).

NigeriaSat-1 is an Earth-Observation microsatellite that enhances sustainable development and support disaster management in the country and other parts of the world. The data is used to address key socio-economic problems in the country, for example revision of the land use/land cover, satellite-based Environmental Change Research in the Niger-Delta Area, Development of Predictive Models for Desertification Early warning, mapping and monitoring of the impact of Gully Erosion in South-Eastern part of Nigeria, settlements and major Roads mapping project, flood mapping in the Kainji lake Area, Deforestation in the south-Western part of Nigeria etc. NigeriaSat-1 is also one of the five satellites of the Disaster Monitoring Constellation (DMC) build to address the need for daily revisit and global coverage to monitor natural disasters and other dynamic phenomena (Akinyede, 2003).

NigeriaSat-2 is consolidating to meet the requirements of a variety of applications which include large-scale mapping and precision agriculture. It will provide Nigeria with valuable geographically referenced high-resolution satellite imaging for applications in large-scale mapping, water resources management, precision agriculture, population estimation, health hazard monitoring and disaster mitigation and management etc.

Capacity building is central to the implementation of the Nigeria space programme. As part of the know-How Technology Training (KHIT) on NigeriaSat-2 satellite project is the development of a training model™ named-NigeriaSat-X. The TM is used to give the KATT's hands on experience in the requirements specification, project management, system engineering, manufacture, test,

assembly/integration and final system of a spacecraft. Unlike the NigeriaSat-1 TM, NigeriaSat- X was built to flight specification and was launched along with NigeriaSat-2 with twelve (12) Nigerian engineers and scientists involved in the building of the satellite using SSTL facilities (Chizea, 2012).

Access to information has become a weapon of mass socio-economic development, as information underscores all developmental effort be it in education, provision of health services, marketing, construction industry, tourism, defence etc. The main benefit of the NigCOMSat – 1 project is to provide a critical and innovative collaboration for capacity building and development of satellite technology for quantum transformation in the telecommunication, broadcasting and broadband industry in Africa, while providing new opportunities and challenging platforms for business in rural and remote regions through access to strategic information in the new world economic order (Boroffice, 2008).

Space exploration capacity to benefit humanity was recognized by high level government representatives from around the world when they convened in Lucca, Italy, in 2011. They concluded that space exploration provides:

> Unprecedented opportunities to deliver benefits to humanity on Earth…. These benefits include fuelling future discoveries, addressing global challenges in space and on Earth through the use of innovative technology, creating global partnership by sharing challenging and peaceful goals inspiring society and especially the younger generations through collective and individual efforts, and enabling economic expansions and new business opportunities (ISECG, 2013: P. 4-5).

Whereas, nations have benefited from the advance in space technology in diverse areas, the benefits have however accrued to Nigeria mostly directly as consumers of products and services engineered and provided either by multinational companies or intergovernmental agencies such as: International Telecommunications Satellite Consortium (INTELSAT), International Mobile Satellite Organization (INMARSAT), Regional African Satellite Communication Organization (RASCOM), Committee on the Peaceful Uses of Outer Space (COPUOS), etc (NSPP, 2009). While some of these products and services have helped to serve the social and economic needs of the country, Nigeria' presently cannot claim to possess the technical know-how to participate actively and independently in space related activities as a service provider. She has thereby remain a nation of consumers of technology because she lacks an indigenous technological orientation and domestication.

Hug (2004) summarizes the motivation for developing countries like Nigeria, to pursue space capability, saying, "competitiveness and long-term growth are achieved through efficient technology management, innovation and technological progress". He goes on to say that, the importance of building technological capacity in developing countries and the significance of the role of the state plays cannot be over emphasized. The basis of sustainable development is the development of the requisite manpower within the nation's industrial, research, and academic institutions for achieving technological, industrial, commercial and economic self-reliance.

CONCLUSION

The drama of space exploration and the wonder of astronomical discoveries interest nations as space has produced an impressive record of benefits for humanity today. Space offers the potential of the resources of the universe which will likely become increasingly important as Earth's resources dwindle through exploitation and use.

Examining the history and politics of space exploration from a political economic perspective, however, can contribute much to or understanding of the dynamics of the world political economy. The age of space exploration has evolved during the period in which capitalism and neoliberal framework have achieved dominance. Therefore, National control of launcher technologies is the only way to guarantee ability to shape the rules of the game. Those who create the operating innovations exercise power by eliminating some possibilities and making some outcomes more likely than others.

There are numerous cases of societal benefits linked to new knowledge and technology from space exploration. This has contributed to many diverse aspects of everyday life, from solar panels to implantable heart monitors, from cancer therapy to light-weight materials, and from water-purification systems to improved computing systems and to a global search-and rescue system. In addition, the excitement generated by space exploration attracts careers in science and technology. The pursuit and domestication of technological capability in space science is a key to national sustainable growth. Nations that are active in space activities are satellite providers and not consumers like Nigeria. Enhanced partnership among government and Academic in Nigeria may advance space capability. Therefore, it would be more desirable to introduce a little more coherence into government dealing with space science to stimulate spin-offs frequently cited as reasons for funding the space programs.

The study in its findings revealed that no nation or group of nations that has space ambition can afford to rely solely on other nations to put their payload in orbit.

The study also find out that national control of launch technologies is the only way to guarantee national access to space activity. For example, Europe developed its integrated launcher programs, first Europa, to ensure that it could launch its own commercial communications satellite in the face of American resistance. And also, China's ballistic missiles and launcher programs derived from its desire for military, economic and cultural independence from both soviet and American models (Harvey, 2001).

Because space exploration stimulates significant global investment and because of its extremely challenging nature, the study recommends the development of cutting edge technical capabilities for Nigeria to address its technology colonization by providing adequate fund in research and science education, engineering development, Design and manufacturing, particularly in the areas of instrumentation, Rocketry and small satellites as well as in satellite data acquisition, processing, analysis and management of related software.

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